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Resumé (Danish abstract)

Rekreativt fiskeri i Danmark er en yndet hobby, som praktiseres i både fersk- og saltvand, med garn og ruse og med stang og hjul. Ikke desto mindre er omfanget af dette fiskeri som oftest ukendt. For at estimere hvor meget torsk, havørred og ål, der blev fanget og hjemtaget i det rekreative fiskeri i 2010, gennemførte DTU Aqua og Danmarks Statistik interviewundersøgelser i juli 2010 og januar 2011.

I undersøgelsen blev de rekreative fiskere opdelt i henholdsvis amatør- og fritidsfiskere og i lystfiskere - på baggrund af hvilken fisketegnslicens de havde indløst. Amatør- og fritidsfiskere fisker primært med garn og ruse, mens lystfiskere fisker med stang og hjul. Da det er lovligt også at fiske med stang og hjul, når man har indløst en fritidsfiskerlicens, blev en tredje gruppe defineret, nemlig lystfiskere der fisker på fritidsfiskerlicens.

I 2010 indløste i alt 152.723 lystfiskere og 33.734 fritidsfiskere årstegn. I estimeringen af den totale fangst har DTU Aqua desuden taget højde for dem, der fisker på dags- eller ugelicens, samt dem der fisker uden den krævede licens. Sidstnævnte gruppe øgede fangsterne i det rekreative fiskeri med 17 % og 24 % for henholdsvis fritidsfiskere og lystfiskere.

I alt vurderer DTU Aqua, at der fanges og hjemtages 116 tons ål [Relative standard fejl (RSE)=10 %], 1666 t torsk (RSE=6 %) og 600 t havørred (RSE=6 %), hvor havørredfangsterne inkluderer den andel der fiskes i ferskvand.

Ål fanges næsten udelukkende i rusefiskeriet, og den totale rekreative fangst udgjorde i 2010 omkring 22 % af de samlede kommercielle og rekreative landinger. Den rekreative torskefangst udgjorde 5,7 %, men varierede fra område til område, og i specielt Kattegat og Øresund udgjorde den rekreative torskefangst en stor andel af den samlede landing (henholdsvis 41 % og 36 %). Omkring 89 % af de rekreativt fangede torsk blev taget på stang og hjul.

Af samtlige de havørreder, der blev fanget og landet, var 90 % fanget med stang og hjul, mens garn og ruse fangede 10 %. Kun 16 % blev fanget i ferskvand og her kun med stang og hjul.

Udover de fisk, der er fanget og hjemtaget, blev der i undersøgelsen også spurgt om, hvor mange fisk fiskerne satte ud igen. Ud fra svarene estimerer DTU Aqua, at der i 2010 blev sat 50.000 stk. (RSE=16 %) ål, over 734.000 stk. (RSE=8 %) havørreder og 1,6 mio. stk. (RSE=7 %) torsk ud igen, efter at de var blevet fanget.

Abstract

Marine recreational fishing is a popular outdoor leisure activity, yet the impact on the targeted stocks is often unknown. In order to estimate 2010 cod, eel and seatrout harvest (fish caught and kept) in the Danish angling and passive gear fishing, two interview surveys were conducted in July 2010 and January 2011. Recreational fishing was separated into anglers (with rod and reel) and passive gear fishing (fyke – and gillnets). In 2010 a total of 152,723 anglers and 33,734 passive gear fishermen had issued the compulsory annual license. In total, it was estimated that 116 t [Relative standard error (RSE)=10 %] eel, 1,666 t (RSE=6 %) cod and 600 t (RSE=6 %) seatrout (including freshwater catches) was harvested in the recreational fishery. Eel are almost exclusively taken in the passive gear fykenet fishery and seatrout was mainly caught by anglers which accounted for 90 % of the total harvest. The estimated cod harvest was also mainly taken by anglers and at least two areas were identified with a high recreational harvest relative to the total yield (commercial landings plus recreational harvest), i.e. the Sound and in Kattegat. Present interview survey indicates that approximately 5.7 % of the total Danish cod yield and approximately 22 % of the total eel yield are taken in the recreational fishing. In the estimation, harvest taken by fishermen without a legal license was also included. This inclusion increased the estimated harvest with 17 % and 24 %, respectively for passive gear and angling.

Glossary

Passive gear fisher: A person fishing with gillnet and/or fykenets. There is also some other fishing carried out by this group, such as hook-fishing for eel, which is not included in this rapport.

Angler: A person fishing with rod and reel and with an angling license. In this rapport there is an additional group of anglers which is those that angle on a passive gear license. The harvest from these two groups are estimated separately, but added when referring to the total angling harvest.

Fishing without a license: Fishery carried out without a license even though mandatory. This group should not be confused with those that carry out illegal fishing, e.g. by fishing in protected areas or during closed seasons.

RSE: Relative Standard Error. Is a percentage that tells how precise the estimated value is. In order to meet the precision level requested from the EU commission RSE should be less than 20.4%. IF an estimate has a low RSE this means that it has a high precision. However, this does not necessarily mean that the estimate is accurate, i.e. are close to the “true” value.

Harvest: Those fish (in tons) that are caught and kept in recreational fishing.

Releases: Those fish (in numbers) that are caught and released again in the recreational fishing.

Recreational catch: All fish caught in the recreational fishing, i.e. harvest plus releases.

Commercial landing: Total Danish commercial landings in tons.

Total yield: Commercial landings plus the recreational harvest in tons.

1 Introduction

1.1 Monitoring of recreational fishing

Within Europe the management of recreational fishing has so far mainly been conducted on a national level without including catches in neither stock assessment nor ecosystem based management (Lewin *et al*.2006; Pawson et al., 2008). However, estimated fishing mortality has in some areas found comparable to - or even exceeding – the mortality caused by the commercial fishery (e.g. Coleman et al., 2004; Morales-Nin et. al., 2005). Therefore there is in many EU member states an increasing awareness about the impact from this type of fishing (Lewin *et al.* 2006). As a consequence the EU Council has since 2008, as a part of the Common Fisheries Policy, obliged member states to estimate the harvest (those fish caught and retained) taken by recreational fishing (EU Council regulation No. 199/2008). Due to this obligation, Denmark has since 2009 initiated a recall survey to estimate quarterly harvest of cod *Gadus morhua*, eel *Anguilla anguilla* and since 2010 seatrout *Salmo trutta*. This report presents the 2010 harvest and releases of the three species in the Danish recreational.

1.2 Method approach

In most European member states information on harvest taken in the recreational fishing is gathered using some sort of recall survey (ICES 2010a). A recall survey is a type of off-site survey which relies on collecting information through mail, telephone or internet interviews. Respondents are asked to recall e.g. their catches, number of fish releases again, fishing pattern or number of days fished, within a specific timeframe. A particular problem with recall surveys is that the longer the timeframe respondents have to recall, the more the results tend to be biased towards an overestimation (e.g. Tarrant et al., 1993).

In September 2009, Statistic Denmark and DTU Aqua developed a concept for a combined telephone and internet recall survey (See Sparrevohn and Storr-Paulsen 2010, *in press*; for further information). This recall survey was further extended in 2010. Initially, one license list interview round was carried out in February 2010 to cover the entire 2009 harvest. In 2010 this design was improved by conducting two surveys thereby limiting the recall period to a maximum of 6 months. Further, the surveys covering the 2010 catches did also include the harvest of sea trout and the number released.

The interview survey presented in this report, has same structure as in 2010, and is separated into two different phases with their own questionnaires and group of respondents: 1) The Omnibus and 2) License holders. The omnibus was only conducted once in 2010 as the results from this interview are not likely to change much. The license list survey was conducted twice covering the two periods from January to June and July to December 2010.

1.3 Recreational fishing in Denmark

Approximately 5.5 million people reside in Denmark; 2.5 million on the mainland and the rest on islands (source: Statistic Denmark, www.dst.dk). Denmark has a very extensive coastline being 7,013 km long and no citizen lives more than 50 km from the nearest coast (Agerskov and Bisgaard, 2011). Recreational fishing in marine waters is therefore an important national outdoor leisure activity. In 1997, 16.5 % of the Danish public considered themselves anglers and 12.5 % claimed to have been fishing within the last year (Bohn and Roth, 1997). Further, it was found that out of those that fished, 25 % fished in streams, 30 % in lakes, 27 % in put & take ponds, but the majority, 73 %, answered marine waters. An economic validation of the recreational fishery underlines the importance of recreational fishery in Denmark, as it was found that Danish willingness to pay for fishing is among the highest in Nordic countries (Roth et al., 2001; Toivonen et al., 2004).

Recreational fishing in Danish coastal waters differs from what is observed in many other countries, especially outside of Europe, in the sense that two major and very different categories of fishing can be identified. The first one is referred to as passive gear fishing throughout this rapport.

Passive gear fishing is carried out using stationary gear such as gillnets and fykenets. The second category of leisure fishing in saltwater is angling.

Table 1. Number of annual angler- and passive gear licenses issued annually. In 2004 no data was available.

	1999	2000	2001	2002	2003	2005	2006	2007	2008	2009	2010
Anglers	150526	151529	156769	150925	152534	160942	156474	160664	160186	157939	152723
Passive gear	33575	31709	33715	33888	33516	33430	34277	33787	35221	34565	33734

Anglers - domestic as well as tourists - between 18 and 65 years of age have to purchase a license costing 19 € for one year, 13 € for one week and 5 € for one day. All passive gear fishers have to pay a license costing 37 € per year and you are not allowed to fish before the age of 12. There are three legal reasons for anglers not to hold a license: 1) persons younger than 18 years or older than 65 years, 2) landowners fishing in their private waters and 3) put & take angling.

1.3.1 Passive gear fishing

Passive gear fishing covers fishing which is carried out using gear such as fykenets and gillnets. For the last 10 years there has on average been 33,700 licenses issued per year (Table 1). The fishery is leisure based and it is illegal to sell the catch. There are restrictions to the effort, as it is only allowed to fish with a maximum of either 3 gillnets plus 3 fykenets or a total of 6 fykenets. The maximum length of gillnets are 45 m and they are not allowed to be closer than a 100 m from the coastline; a restriction mainly set up to protect seatrout. Further, there are several protected areas such as areas around river mouths, where net are illegal. The gear is typically deployed from a small boat with a limited activity radius, which in practice makes this type of fishing more or less stationary.

The main targeted species are eel caught in fykenets and flounder *Pleuronectes flesus* caught in gillnets (Sparrevohn et al., 2009). It is a traditional fishery that has been practiced for centuries in the coastal areas. Earlier, a recreational fishery using eel-trawl and long-lines was also practiced but eel-trawl is now prohibited and long-line catches are limited. Cod and sea running trout are caught both with gillnets and fykenets in the passive gear recreational fishery, but the catches are believed to be restricted to certain areas (Sparrevohn et al., 2009).

1.3.2 Angling

Angling in saltwater are carried out in waders along the coastline or from structures such as peers, bridges or with boats as a platform. The majority of anglers (73 %) are fishing in marine waters (Bohn and Roth, 1997). During the last 10 years the number of annual licenses issued per year has on average been 155,600 (Table 1). The number of weekly license issued in 2010 was 17,305 and for daily license a total of 23,716 licenses were issued. There are no restrictions, e.g. bag-limit, to angling fishery in saltwater besides those that apply to fishing in general, i.e. closed areas, minimum landing size etc. The only exception is that trolling closer that 100 m from the coastline is prohibited. The main target species in saltwater is seatrout, but garfish *Belone belone* and cod are also regularly caught as well as salmon and various flatfish species (Rasmussen and Geertz-Hansen, 2001). Seatrout is besides also caught in freshwaters.

Platforms used when targeting cod range from beach fishing with rod and reel using casting lures to deepwater jigging onboard chartered boats many miles offshore. There is also a substantial fishing focusing on wrecks. Angling for cod on board private boats is in addition very popular and could probably accounts for a large fraction of the total harvest, at least locally.

2 Methods

A combined telephone and internet survey based upon two questionnaires, the “Omnibus” and the “License list”, were developed by Statistic Denmark and DTU Aqua. The interviews were conducted by Statistic Denmark as they hold the expertise in this form of surveys. The questionnaire was prior to the 2009 interview tested upon a subgroup of fishermen, to optimize the process and reformulating questions that potentially could lead to misunderstandings. DTU Aqua was responsible for the following data processing.

2.1 Omnibus interview

The Omnibus is a monthly interview survey conducted by Statistic Denmark wherein questions are asked on behalf of e.g. companies, newspapers and research institutes. In 2009 three telephone interview rounds were conducted were questions on recreational fishery were included and in 2010 one additional omnibus survey was conducted in March. The recreational fishery questions were embedded as a minor part of this interview, hence the nonresponse bias is expected to be insignificant. Respondents were selected by telephoning a random number. The interview was conducted with that person within the household who last had birthday. Only citizens between 16 and 74 were included. A total of 958, 957 and 968 were interviewed and answered in 2009 and in March 2010 a total of 985 were interviewed. The main objective was to estimate the population size that fished without a license and their effort.

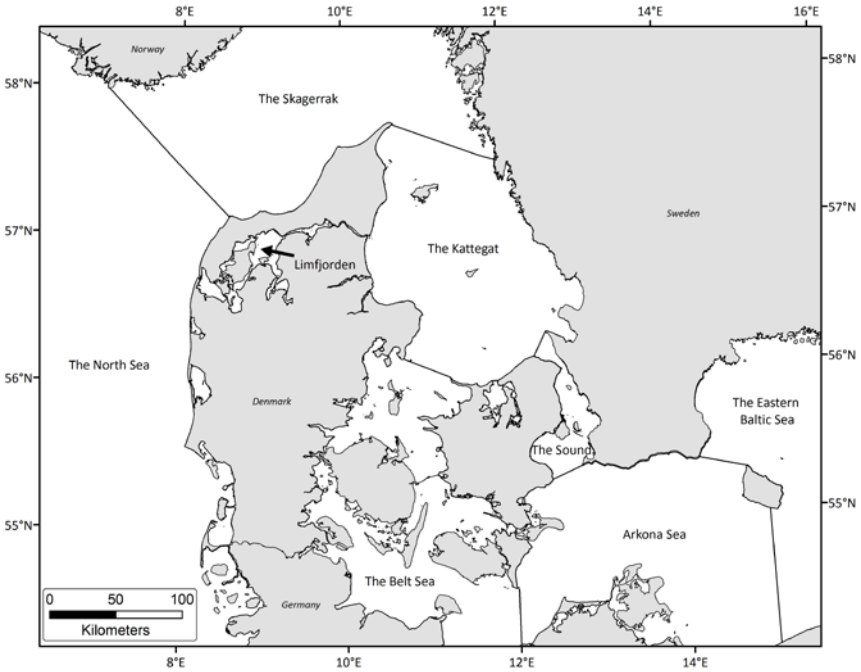

Fig. 1. Area definition used in the interview survey.

Fishermen not holding a license were asked for their reasons. There are several legal exemptions from the compensatory license for angling fishing (see section 1.3). Passive gear fishers do not have any legal excuse for not holding a license when fishing in saltwater.

Furthermore, respondents were asked for information on effort in fishing days to be able to estimate whether people fishing without a license are fishing with same effort as people holding a license. These questions provided the needed information for calculating the fraction of illegal

fishermen and the effort they fished with. Respondents were also asked about their fishing pattern outside Denmark, such as countries they had visited for fishing.

2.2 License interview

This recall survey targeted fishermen with a valid annual license at the time of the interview. The main difference between the 2009 and 2010 "license list" questionnaires was 1) that seatrout harvest was included 2) questions about released fish was asked and 3) two interview rounds 6 months apart was conducted. In order to estimate the 2009 harvest only one interview round was carried out in 2010, which means that in the maximum recall period was 12 months for the 2009 data whereas this was only 6 month in 2010. The data in this report are based upon interview rounds that were conducted in July 2010 and in January 2011. Since two different license lists are available, one for anglers and one for passive gear fishermen, there was conducted two surveys with quite identical questionnaires. Independent of list, the respondent was randomly selected and initially contacted by letter wherein they were encouraged to answer the questions via the internet. If no respond was detected after a period of two weeks, the respondent was contacted by telephone and - if reached - encouraged to answer via the internet or via telephone. This questionnaire contained detailed questions on species harvested, numbers released and fishing effort within the last 6 months. The respondent was explicitly told to distinguish between the part of the catch kept (i.e. the harvest) and the part released (discarded). To estimate harvest by ICES managing areas (Fig. 1) and quarter the respondents were asked to provide the information per area and quarter. In the Danish license system it is also possible to issue a license valid for one day or one week. However, the number issued of these licenses is relatively small compared to the number of annual licenses. Therefore, no separate interview was conducted for these two groups. However they were accounted for in the total harvest estimation.

Purchasing a license for passive gear fishing automatically gives license to angle with rod and reel as well. To include this group in the estimates, all passive gear fishermen were asked whether he/she also angled, a group referred to as "angling with a passive gear license". An additional interview was therefore conducted on this group in order to estimate their harvest when angling.

2.2.1 Telephone contra intranet

An analyze was conducted where the total estimated harvest was calculated based upon either 1) those respondents that had responded via the internet or 2) those that was later contacted by telephone and answered there. The motivation for conducting this analyzes was: if no differences were found it would not be necessary to contact respondents via telephone in the future, an exercise which is the most costly part of the interview round.

2.3 Analytical methods

Estimating the total harvest or numbers released of cod, seatrout and eel in the Danish recreational fishing was done by estimating the harvest on basis of the reported catches from the license list recall survey. These values were then extrapolated to the entire population of fishermen (all license holders and fishermen without a license) using the effort information collected during the omnibus survey. Different effort levels for those fishing without a license, on a weekly or on a daily license were accounted for in the calculation. To compute the total harvest or released numbers $\hat{Y}_{ij}$ of either cod, seatrout or eel per quarter (i) and area (j) the following equation was used,

$$\hat{Y}_{ij} = \frac{\sum_{k=1}^{n_{ij}} y_{ijk}}{n} N \qquad (1)$$

where n is the number of respondents and y the reported harvest per respondent (k). The total population N is computed as:

$$N = \left(\rho_a + \rho_w \cdot \frac{\varepsilon_w}{\varepsilon_a} + \rho_d \cdot \frac{\varepsilon_d}{\varepsilon_a} + \rho_m \cdot \frac{\varepsilon_m}{\varepsilon_a}\right) \quad (2)$$

where ρ is the number licenses issued being valid for a year (a), week (w) or day (d). The number fishing without a license (m) was computed using the estimated percentage that fished without a license even though obliged to have one (Table 3), multiplied with the actual number of Danish citizens between age 18 and 65, which 1 January 2011 was 3,408,000 persons (Agerskov and Bisgaard, 2011). The values were weighted with the fishing effort ε which for those holding an annual license was derived from the omnibus survey and assumed to be 1 day for those holding a daily license and 3 days for those holding a weekly license. All values used can be found in Table 2.The standard error of (1) was computed according to Cochran (1977, page 37) as:

$$s\left(\hat{Y}_{ij}\right) = \frac{Ns'}{\sqrt{n}}\sqrt{1 - \left(\frac{n}{N}\right)} \quad (3)$$

Where s'^2 is calculated as:

$$s'^2 = \frac{1}{N-1}\left(\sum_{ij=1}^{n} y_{ij} - \frac{Y'^2_{ij}}{N}\right) \quad (4)$$

For (4) applies that $Y'_{ij}=Y_{ij}$ if the unit is in the ij^{th} domain and 0 if not. The relative standard error (RSE) was computed as the standard error divided by the estimate. In the license list survey the respondent had the opportunity to report harvest in either kilo or counts. Therefore, it was necessary to find an average weight of a harvested fish in order to adjust from counts to kilo. The average size of eel and cod above minimum landing size caught in the passive fishery was found from Sparrevohn et al. (2009). Eel larger than the minimum landing size caught in fykenets was set to 47 cm corresponding to a weight of 188 g. Cod caught in fykenets above the minimum size was set to 39 cm corresponding to a weight of 540 g. Cod caught in gillnets was set to 47.5 cm, which corresponds to 975 g. Since no estimate on the average weight for cod caught and kept angling was available a value of 1,500 g per fish was chosen. For seatrout the average weight was set to 2,300 g when caught and kept in gillnets (Sparrevohn et al., 2009) and 1,700 g when caught and kept either in fykenets or while angling.

Table 2. Values used in eq. 1-4 for estimating harvest and RSE in passive gear fishing and angling. Effort is in days per year. The respondent number (*n*) given left to the slash is for the interview covering 1st and 2nd quarter and the value right is the interview covering the 3rd and 4th quarter.

	Respondents (*n*)	License (*ρ*)				Effort (*ε*)			
		Year (*a*)	Week (*w*)	Day (*d*)	Without (*m*)	Year (*a*)	Week (*w*)	Day (d)	Without (*m*)
Passive gear	1904/1970	33,734	-	-	16,609	30.8	-	-	10.8
Angling	1789/1991	152,723	17,305	23,716	92,511	9.7	3	1	4.4

3 Results

3.1 Omnibus interview

During the four interview rounds in October, November, December and January a total of 3,868 persons were interviewed. When asked whether they had fished within the last twelve months, between 13 and 16 % confirmed. Approximately 10 % of these were fishing with passive gear, 90 % were anglers and 0.1 % fishing commercially.

Table 3. Table 3A shows the numbers of respondents (*n*) in the Omnibus in October-December 2009 and January 2010. In table 3B the numbers were scaled up to actual population size of person between 18 and 74 (N), which 1 Jan. 2010 was 3,416,369 (Agerskov and Bisgaard, 2010).

A			Do you fish?	Do you have a license?				
	(n)		Yes	Yes	No	No- legal	No-illegal	% illegal
Dec	968	Angling	116	58	58	30	28	24.1
		Passive gear	9	7	2	0	2	22.2
Nov	957	Angling	132	69	63	33	30	22.7
		Passive gear	17	8	9	2	7	41.2
Oct	958	Angling	119	59	60	34	26	21.8
		Passive gear	14	8	6	3	3	21.4
Jan	985	Angling	134	89	45	23	22	16.4
		Passive gear	21	11	10	3	7	33.3
B			Do you fish?	Do you have a license?				
	(N)		Yes	Yes	No	No- legal	No-illegal	% illegal
Dec	3,416,369	Angling	409,400	204,700	207,700	105,879	98,821	24.1
		Passive gear	31,764	24,705	7,059	0	7059	22.2
Nov	3,416,369	Angling	465,868	243,522	222,346	116,467	105,879	22.7
		Passive gear	59,998	28,234	31,764	7059	24,705	41.2
Oct	3,416,369	Angling	419,988	208,229	211,758	119,996	91,762	21.8
		Passive gear	49,410	28,234	21,176	10,588	10,588	21.4
Jan	3,416,369	Angling	472,927	314,108	158,819	81,174	77,645	16.4
		Passive gear	74,115	38,822	35,293	10,588	24,705	33.3

3.1.1 Fishing without license

For both groups of recreational fishermen a significant part was found not to have a license. However some did not hold a license due to a valid reason. Excluding the group that did not hold a license for valid reasons, 21 % of all that claimed to have had angled within the last 12 months were doing so without a license, even though carrying out a fishery where license is necessary (Table 3). For the passive gear fishermen, the number of people not holding a license is larger and on average for the four Omnibus surveys 30 % fished without a license. The level fluctuated for passive gear fishermen between surveys properly due to fewer persons available in the latter group. Therefore the interpretation of these data should be done with some caution. Further there appeared to be a bias in separating between anglers and passive gear fishery in the first two omnibus surveys since some of the passive gear fishers gave meaningless answers to why they did not hold a license. For example, several passive gear respondents answered that they only

fished in put & take, an answer that does not make any sense, since a fishery with gillnets or fykenets in put & take lakes does not exist. The problem was recognized and it was emphasized that respondents should have a clear understanding of the difference between anglers and passive gear fishery. In this investigation we have used the average for the four omnibus surveys to up-scale the illegal fishery.

3.1.2 Effort

Since it was expected that that effort between fishers holding a license and fishermen without was different, the effort was estimated in order to account this in the total catch estimation (see eq. 2). Results indicate that for anglers fishing without a license, the effort was approximately one third compared to anglers fishing with license. For passive gear fishers the effort for people without a license was a little lower than half, compared to fishers with a license (Table 4).

Table 4. The average days fished for anglers and passive gear fishers with either a license or illegally.

	Angling		Passive gear	
	With license	Illegally	With license	Illegally
November 09	8.5	2.2	24.0	10.7
December 09	9.9	4.2	25.4	16.5
January 10	9.7	4.4	30.8	10.8

3.1.3 Fishing in other countries

In the omnibus interview the respondents were asked about fishing habits abroad. The percentage that fished in other countries was in the four surveys between 2.1 and 3.3 % of all interviewed. Sweden and Norway were by far the most important countries visited (Table 5). On average approximately 60 % reported one trip to other countries but some reported as many as 20.

Table 5. Respondents that fished in other countries from the four different omnibus surveys. Total numbers of respondents can be found in table 2.

	October	November	December	January
Sweden	11	7	16	8
Norway	9	3	6	5
Faroe Island	3	2	0	2
Great Britain	0	0	0	1
Greenland	1	0	2	1
Rest of Europe	4	3	7	1
Rest of the world	3	6	5	7
Respondents that fished outside of Denmark	28	20	32	25

3.2 License interview

The refusal rates were very low in the investigation as only 2 % and 4 % for the anglers and passive gear fishermen refused to answer (refuse and other reason, Table 6). The very high level of responses in the surveys qualifies the investigation.

Table 6. Distribution of non-respondents and there motive for not responding.

Anglers

	Metode			Total
	1. Tel	2. Web	9. No answer	
1. Answer	1,726	2,054	0	3,780
2. Not meet	0	0	562	562
3. Refuse	0	0	81	81
4. Other reasons	0	0	25	25
5. Language problems	0	0	4	4
6. Not relevant	0	0	0	0
7. No contact on tel.number	0	0	69	69
8. No tel.number found	0	0	301	301
Total	1,726	2,054	1,042	4,822

Passive gear

	Metode			Total
	1. Tel	2. Web	9. No answer	
1. Answer	2,096	1,778	0	3,874
2. Not meet	0	0	495	494
3. Refuse	0	0	115	115
4. Other reasons	0	0	44	44
5. Language problems	0	0	5	5
6. Not relevant	0	0	2	2
7. No contact on tel.number	0	0	39	39
8. No tel.number found	0	0	245	245
Total	2,096	1,778	1,020	4,894

We calculated the total estimated catches using 1) the total numbers of respondents, 2) only those that had answered vie the internet and 3) only those that had answered via the telephone (Table 7). A bias was clear when only using those answered via the internet as this underestimate the catches compared to the total estimates. Contrary, using only the internet answers overestimated the catches. This bias was connected to the fact that the percentage of respondents that had not fished was for both anglers and passive gear fishermen higher when answering via the telephone contra via the internet.

Table 7. Comparing the total estimated catch using either; all respondent, those that has answered via internet or those that answered via telephone. The percentage that had a valid license but has not fished in either 1st and 2nd quarter or 3th and 4th is also shown.

Angling		All	Phone	Internet
	Cod	1,164 t	803 t	1,463 t
	Trout	440 t	261 t	455 t
	Has not fished 1st and 2nd	41 %	48 %	36 %
	Has not fished 3rd and 4th	47 %	59 %	37 %
Passive gear				
	Eel in fykenet	116 t	90 t	145 t
	Cod in gillnet	139 t	97 t	170 t
	Trout in gillnet	55 t	37 t	62 t
	Has not fished 1st and 2nd	60 %	63 %	55 %
	Has not fished 3rd and 4th	48 %	57 %	40 %

3.2.1 Passive gear fishers

A total of 4,894 persons were tried contacted and 3,874 participated in an interview. 1,778 answered via the internet and 2,096 via the telephone survey (Table 6). Less than half of the passive gear fishers answered that they had been fishing within the last 6 months. In 2009 61 % answered that they had been fishing within the last 12 months. The respondents were asked to give their harvest, release and fishing pattern on a three month interval. A total of 1,760 fished with gillnet, fykenet or a combination (Table 8).

After completing questions about passive gear fishing and catches, the respondent was asked whether he/she also fished with rod. To that 63 % confirmed but only 64 % of those had actually fished within the last 6 months. This high level was also found in the 2009 interview which led us to analyze the fishery of this group separately from the rest of the anglers. A Fishery referred to as “angling with a passive gear license”.

Table 8. Different gear used in the passive gear fishing. Total represents all those that fish with either gillnet, fykenet or both.

Total	Exclusively. gillnet	Exclusively fykenet	Both
1,760	1,108 (62 %)	261 (15 %)	391 (22 %)

3.2.2 Anglers

Of the 3,780 anglers that participated in the interview only 54 % had actually been fishing within the last 6 months, although they had a valid license.

3.3 Harvest

The total harvest estimate was upscaled with 24 % for the angling fishing and 17 % for the passive gear fishing due to the inclusion of the illegal fishing without a license.

3.3.1 Cod harvest

A total of 1666 t (RSE=7 %) cod were harvested in the Danish recreational fishery in 2010 (Appendix A). Cod were harvested with all gears but with the main contribution (89 %) came from the angling fishery. Only 8 % of the harvest derived from the gillnet fishery and 3 % came from fykenets.

The angling harvest of cod is quiet evenly distributed in the first three quarters of the year but in the last quarter only 13 % of the harvest was taken.

The most important area for cod harvest were the Sound were 28 % of the total cod harvest were taken followed by the Belt Sea with 25 % and Skagerrak with 20 %.

3.3.2 Eel harvest

A total of 116 t (RSE=10 %) eel was harvested with fykenet in Danish recreational fishing (Appendix B). The majority (61 %) was taken during the third quarter. The most important area was the Belt Sea which alone accounted for 43 % of the total eel harvest followed by the Sound with 10 % of the total harvest.

3.3.3 Seatrout harvest

Seatrout was predominately harvested angling (90 %) (Appendix C). In total 600 t (RSE=6 %) was caught and kept annually and out of these 538, 2 (RSE=7 %) was harvested angling. For angling, the three most important marine areas identified was the Belt Sea [157 t (RSE=10 %)], Kattegat [91.6 (RSE=15 %)] and the Arkona sea [72.3 (RSE=36 %)]. The total harvest in freshwater accounted for 15 % of the recreational harvest.

3.4 Release

Opposite to the harvest the estimated release are provided in numbers since no average weight of fish released are available. The numbers released per kilo harvested was calculated for each species on an area level (Fig. 2).

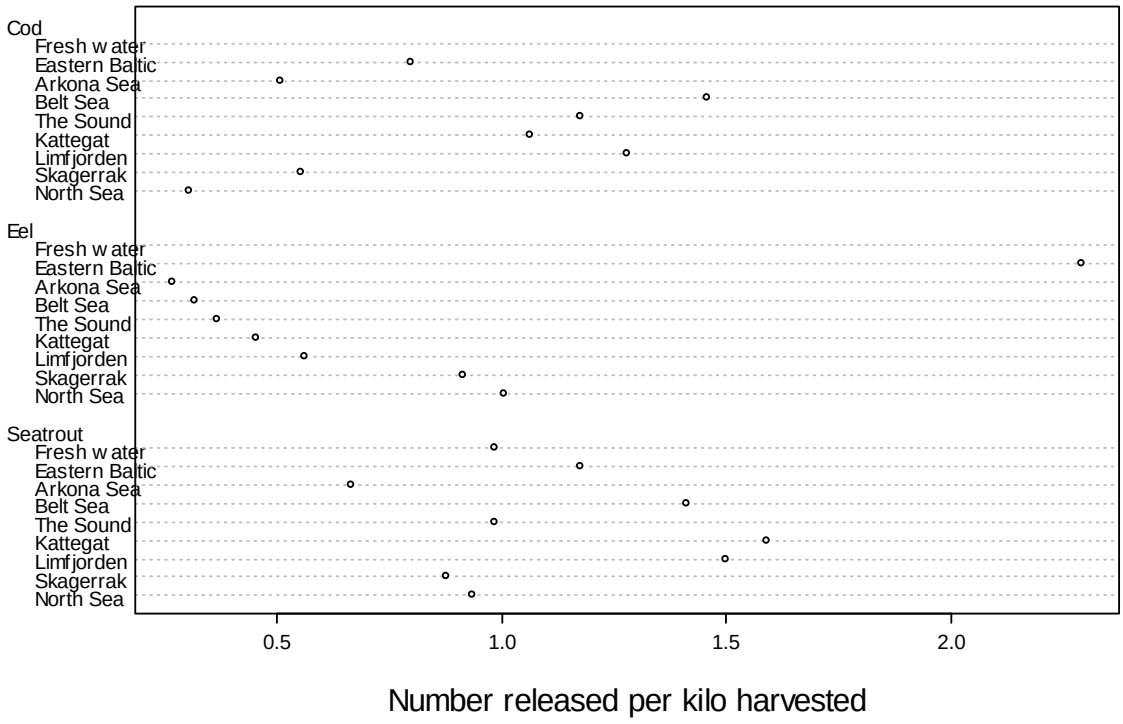

Fig. 2. Number of fish released per kilo harvested.

3.4.1 Cod releases

It was estimated that more than 1,600,000 (RSE=7 %) cod was released during 2010 in recreational fishing (Appendix D). The Belt Sea, Kattegat, Limfjorden and the Sound are those areas where the highest number are releases relative to the kilo harvested. Neither the average

weight nor the survival of those cod released is known. The mortality of the cod released is likely to be high since the majority of the cod released [1,540,000(RSE=7 %)] are released angling in quite shallow areas. Hence, the cod released are unlikely to suffer from serious anatomical traumas caused by inflated swimblatter.

3.4.2 Eel releases

The number of eel released was the smallest of the three species investigated (Appendix E). Around 50,000 (RSE=16 %) individuals was released and the numbers per kilo harvested was less than 1, except for the Baltic were the estimated harvest and release was associated with very high relative standard errors (RSE=50 % and RSE=75 %, respectively). The mortality of the released eel is likely low, since all ell are caught with fykenets and eel in general is rather insensitive to physical disturbance.

3.4.3 Seatrout releases

More than734,000 (RSE=8 %) seatrout was released in 2010 (Appendix F). The Arkona sea was the area where the lowest number of fish was released per kilo harvested. This corresponds well with anecdotic information that claims a high average size of seatrout in the area around Møn and Falster.

4 Discussion and conclusion

4.1 Discussion

In the present study the total Danish recreational seatrout, eel and cod harvest and release was found by; 1) estimating the harvest/release from a subsample of persons that has issued a license within the last 12 month and 2) estimating the amount of fishing carried out without a valid license. The latter was done using an interview survey targeting the entire Danish population between the age of 16 and 74, i.e. the omnibus survey. In the four omnibus surveys conducted, the number of anglers between 16 and 74 years which had practiced their hobby within the last 12 month was between 400,000 and 460,000. This corresponds to between 12 and 14 % of the Danish population which is very close to 12.5 % which was found in 1997 (Bohn and Roth, 1997). In another survey, relying on an interview panel, the number of anglers in Denmark was estimated to be 616,000 (COWI, 2010). The number of anglers that claimed to have issued a license was between 308,000 and 201,000 whereas the actual number of license issued - including weekly and daily licenses - is around196,000. According to the omnibus interview survey between 24,000 and 38,000 claimed they had a license for passive gear fishing which is close to the actual number of licenses sold, which is around 34,000. The margin between respondents that claimed to have a valid license and the actual number of license issued is relatively small. In 2010 the number of annual angler license issued were 152,723; weekly license was 17,305 and daily 23,716, summing to a total of 193,744, which is 20 % lower than the persons that claimed to have had a valid license (an average value for the four omnibus survey).

4.1.1 Eel

In recreational fishing eels are mainly harvested in fykenets in saltwater, even though some freshwater fishing for eel exists. The intensity of the freshwater fishing is unknown since it can be carried out legally for all landowners along lakes and rivers. In the commercial fishery the landings from lakes are very low compared to those in saltwater. Of the total landings reported from 2005 to 2009 only between 2 and 3 % was from lakes (www.fd.dk).

Since fykenets set in saltwater are rather sensitive to wave and current action this fishing is mainly carried out in the inner Danish waters where wind and wave protected Fjords, Belts and Sounds are located. This is reflected in the very low harvest of eel in the North Sea, Skagerrak and Eastern Baltic. The same pattern as last year was observed in 2010 where the Belts Sea was the area with the highest harvest followed by Kattegat and the Limfjord. Similar eel were not harvested equally throughout the season in 2010. In 2009 the highest harvest were reported in the period from August to October, which in 2010 roughly corresponds to the period from July to September. In 2009 the fishery with fykenets for eels was closed in the period from 10th of May to the 31st of July (Anon 2008). This is reflected in our survey as low harvest during the period from May to July in 2009 and April to June in 2010. Periods which traditionally have been months with a high CPUE of eel (Pedersen et al., 2005). The total harvest, including fishery without license was in our investigation estimated to be 116 (RSE=10 %) t which is a slight increase compared to the 104.4 (RSE=13 %) t estimated in 2009 (Sparrevohn and Storr-Paulsen, in press). In 1997 the total catch of eel in the legal recreational fishery was estimated to be 138 t, which at that time corresponded to 20 % of the total eel yield (recreational harvest plus commercial landings) (Anon, 2008). The commercial landings were in 2010 on 408 t hence the recreational fishing harvested an equivalent of 22 % of the total Danish eel yield. In 2009 the figure was slightly lower at 19 %.

4.1.2 Cod

In 2009, Sparrevohn and Storr-Paulsen (in press) estimated that nearly 1,231 (RSE=6 %) t cod were harvested in recreational fishing during 2009. In 2010 this was somewhat higher, i.e. 1,666 (RSE=7 %) t. Similar to 2009 the main part of cod harvested in the recreational fishery was angled.

Anecdotal information has highlighted the Sound as an important recreational cod fishing area but also The Belt Sea and Skagerrak showed in our survey high harvest. Commercial landing in the Sound has between 2004 and 2008 been fluctuated around 1,900 t (ICES 2010). The commercial landings in the Sound are mainly from a small area north of Helsingør called "Kilen" were it has been legal to trawl, opposite to the rest of the Sound where a trawling ban has been in place since 1932. However, a spatial and temporal closure (to protect the cod in the main spawning season) of the Sound commencing early in 2009 for both recreational and commercial fishery and reduced the commercial landings to 630 t in average the last two years (ICES, 2011). Due to the large decline in commercial catches later years the recreational fishing in 2010 accounts for 41 % of the total Danish Sound cod yield and angling alone for 37 %. Angling harvest might be even higher, since cod harvest reported in numbers was converted into weight assuming an average mass of 1500 g. The average weight of cod caught and kept by anglers in the Sound is likely somewhat higher at least during the winter where spawning fish are targeted and fish larger than 10 kg are caught regularly. However, although the Sound was the area with the highest total recreational harvest of cod it is not necessary reflecting an overfishing of the stock. Actually, the Sound cod is considered to be in a relatively healthy condition, with a high CPUE and a wide age distribution compared to the adjacent waters (Svedäng et al., 2004; Svedäng et al., 2010). In the Western (SD 22-24) and Eastern (SD 25-32) Baltic Danish commercial fishing for cod accounted for 7,500 t and 10,700 t in 2010, respectively (ICES 2011). In this light recreational fishing was relatively important for the western area and minor in the eastern accounted for an equivalent of 12 % in west and less than 1 % of the total cod yield in the eastern Baltic. Anecdotal information has highlighted a large fraction of German anglers fishing in the Danish part of the Western Baltic. However, it has not been possible to quantify the amount fished by foreigners as it is possible in Denmark to purchase a license for a day or a week without providing any personal information. Therefore, it has not been possible to contact this fraction of the fishery.

In Kattegat, 66 (RSE=20 %) t cod was harvested in recreational fishing; 53 (RSE=25 %) t was from angling and 14 (RSE=21 %) t from gillnet and fykenet fishery. However, due to the present very low commercial quota (270 t) and landings (117 t) in this area the recreational harvest are equivalent to 36 % of the total cod yield in this area.

In the North Sea and Skagerrak the commercial Danish landings were by ICES estimated to be 5,700 t and 3,300 t, respectively in 2010 (ICES 2011b). The harvest in the recreational fishing from these areas was estimated to be 226 (RSE=24 %) t and 330 (RSE=18 %) t respectively corresponding to an equivalent of 4 % and 9 % of the total cod yield. Overall, our investigations indicate that a little increase in the total Danish recreational cod harvest happened in 2010 where 5.6 % of the total yield was from the recreational fishery compared to 4.5 % in 2009 (Sparrevohn and Storr-Paulsen, in press).

4.1.3 Seatrout

For anglers in Denmark the most important species is seatrout, which it is caught both in marine and fresh waters (Rasmussen and Geertz-Hansen, 2001). A dispute between anglers and passive gear fishermen - about which of the two groups that is responsible for the main harvest - has been ongoing for several decades. This has resulted in e.g. restriction in the gillnet fishery where it has been prohibited to fish closer than 100 m from the coastline. This ongoing dispute could potentially influence the result of a recall survey. That 90 % of the harvest is estimated to be taken by anglers and 10 % by passive gear fishermen could therefore be biased in the sense that there could be a reluctance to admit high catches. Further it should be stressed that a survey like the one presented here will not include those that fish illegal in protected areas or during closed seasons.

Like for cod in the sound, there might be a tendency for underestimating the harvest in the Arkona Sea, since this area, according to anecdotic information are an area with a high average weight. The same might very well be that case for fresh water where mainly mature individuals are caught. More than 734,000 (RSE=8 %) are released every year by anglers. Besides undersized fish also spent and mature individuals are released. If we assume that the average weight of those fish harvested is 1,700 g then around 316,000 individuals are in harvested by anglers during 2010. Assuming that the average weight is correct then approximately every three out of four seatrout caught angling is released again. The number released in the passive gear was only 1.2 % of that released by anglers. This might reflect the fact that the mortality when caught in gillnets is probably much higher than when caught angling together with much higher size selectivity in gillnets.

4.1.4 Sources of error

Relying on respondent ability to remember catches or effort within a specific time period are followed by a number of biases such as digit preference, telescoping, non-responding bias and rule-based estimation. Digit preference means that the respondent will have a tendency for rounding figures to 0 or 5, a tendency that will increase with increasing recalling period (Huttenlocher et al., 1990). In this study we did see a tendency for some digit preference especially when reporting the catch in weight but whether this would increase or decrease the total estimated harvest is difficult to decide. Telescoping is the tendency for respondents to report an event, such as the catch of a trophy fish, even though it actually happened outside the time frame asked. This could potential mean an overestimation, especially in the angling harvest of cod, where some trophy fishing takes place. The bias introduced by non-respondents emerges since those fishermen with the lowest participation rate will have the highest non-responding rate (Tarrant and Manfredo, 1993), but since the non-respondent rate in present survey was very low this is not likely to have caused any major bias. Another potential source of bias is the risk that a rule is applied by the respondent when trying to remember the catches during the last 6 or 12 month. Typically, an average catch per trip is memorized and then multiplied with the assumed number of trips. This can potentially lead to a severe overestimation of the harvest, because there is a general tendency for exaggerating the participation rates in recreational events, there among fishing (Tarrant et al., 1993). For fishing it has been estimated that the effort was overestimated with 45 % in a 12 month recall period compared to diaries (Connelly and Brown, 1995). This could impose a large overestimation in present study, especially for the passive gear fishing where it seems likely that some applies a rule, such as multiplying on average catch per gillnet or fykenet with the recalled number of days fished. This should be investigated further e.g. as suggested by the ICES Planning Group on Recreational Fisheries (ICES, 2010a) by a dual frame approach where recall surveys are supported by either diaries or on-site surveys, such as access point interception or aerial based counting (Vølstad et al., 2006).

The angler recall survey only targets Danish citizens, even though tourist are also obliged to issue a license in order to fish legal in Denmark. In our study around 3 % of the Danes interviewed had fished as tourist in other countries, especially Sweden which is very close and easy accessible. There is no precise estimation of the number of tourist travelling to Denmark to fish, but the potential number of angling tourist is high. In Germany there is around 3,300,000 anglers (Anon., 2007) and for the Berlin-Brandenburg population around half claimed to have been on an angling holyday within the last year (Arlinghaus et al., 2008).

When estimating the harvest, the RSE for the passive gear estimates was in general higher than for angling. When computing the RSE it is assumed that the population sampled is infinite and if this assumption is not meet, then the RSE tends to be overestimated. However, as long as the number of respondent does not exceed 5 % of the population surveyed, the finite population correction can be ignored and the overestimation will be minor (Cochran, 1977, p. 24). In the case of anglers less than 1 % of the total number of anglers was included in the survey but

for passive gear fishermen 4.6 % of the population was actually sampled. Hence, it could be argued that – at least some of the elevated RSE – is caused by the estimation method. It could also be this group of fishermen actually is more heterogeneous than anglers. The heterogeneity of anglers and their behavior patterns are unquestionable important and has been investigated in several papers (Arlinghaus et al., 2008; Johnston et al., 2010), but whether these results can be applied to passive gear fishermen are not known.

4.1.5 Fishing without license

The inclusion of illegal fishing in was significant. Approximately 20-25 % reported that they fished illegally, though with a lower effort which corresponded to an increase in the passive gear catches on 17 % and 24 % for angling. One exception was in the November omnibus survey where 41 % of the passive gear fishers reported they fished without a license. However, there seemed - at least during the first interview round - to be a problem for respondents to differentiate between being fishing with passive gear ("fritidsfisker" in Danish) and angling ("lystfisker" in Danish). Indication of some misunderstanding of the classification during the two first interview rounds in October and November was that respectively 3 and 2 respondents claimed that they did not need a license. As arguments for that they used reasons that do not make sense when fishing with a passive gear. E.g. claiming to only fish in put & take lakes. In December, where the confusion had been resolved none of the respondents claimed not to need a license. Therefore, this single high percentage of illegal fishery (41%) should be treated with caution. Another aspect when asking people whether they have fished illegally is the risk of under estimating the numbers since the respondents might be tempted to claim to hold a license when they actually do not.

4.2 Conclusion

Using a license list recall survey and including those fishermen that fished without a license showed that the recreational harvest was in some of the areas comparable to the commercial landings. This is a result of decreasing commercial landings more than it actually illustrates that recreational fishery in general imposes large fishing mortality. Nevertheless, it exemplifies that especially when stocks are overfished and below its caring capacitive the fishing mortality caused by recreational fishing can be an important factor that should be incorporated into stock assessment, recovery plans and ecosystem bases management. The harvest of fishermen without a valid license was important as it increased the estimated harvests with 17 % for the passive gear fishing and 24 % for angling. Hence, recall surveys designed to estimate harvest and catches should not be based upon fishing license list alone but should also including those fishing without the mandatory license.

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Appendix A: Cod harvest (*y*) in tons per year with corresponding relative standard error (RSE). The number of respondents that reported a harvest within a given domain is denoted h.

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Total		
		y	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h
Cod harvest in fykenets	Jan-Mar										0,9	87	2	0	98	1	2,6	67	4							3,5	100	7
	Apr-Jun				0,4	83	2	0	98	1	0	98	1	0	98	1	4,9	35	13	0,2	71	2				5,5	62	20
	Jul-Sep							1,4	78	5	2	38	9	2,1	44	7	13,9	35	36	1,1	47	7				20,5	26	64
	Oct-Dec							0	97	1	0,5	76	3	8	86	6	8,8	57	25	0,7	60	4	0	97	1	18,0	31	40
	Total				0,4	83	2	1,4	78	7	3,4	34	15	10,1	69	15	30,2	25	78	2,0	34	13	0,0	97	1	47,5	17	131
Cod harvest in gillnets	Jan-Mar	2,6	70	2	1,1	62	3	0	98	1	2,1	56	6	6,4	65	11	9,2	29	29	6,4	48	9	5,6	54	5	33,4	18	66
	Apr-Jun	0,9	64	4	4,5	59	7	0	98	1	2,5	33	16	2,4	36	11	5,8	23	49	4,3	47	14	8,6	55	9	29,0	21	111
	Jul-Sep	0,1	97	1	8,6	60	9				4,4	48	17	5,1	42	15	9,4	21	52	3,5	59	11	2,5	49	6	33,6	19	111
	Oct-Dec	0,5	86	2	8,4	59	7	0,2	97	1	1,2	53	7	17,1	92	11	11,9	27	37	2,3	68	8	1,3	69	2	42,9	16	75
	Total	4,1	48	9	22,6	34	26	0,2	97	3	10,2	26	46	31,0	53	48	36,3	13	167	16,5	27	42	18,0	32	22	138,9	9	363
Cod harvest angling with a passive gear license	Jan-Mar	5,9	44	9	11,6	36	14	0,1	98	1	1,6	60	5	16,7	23	43	16,3	28	44	5,1	46	8	2,9	65	7	60,2	12	131
	Apr-Jun	16,1	23	28	20,9	21	38	1,5	98	1	9,7	56	12	19	30	41	22,6	23	60	24,6	75	18	6,1	39	15	120,5	17	213
	Jul-Sep	13,7	72	9	23,8	29	25	0	97	1	3,6	45	15	21,5	22	50	15,8	30	50	3,8	56	10	8,6	64	8	90,8	16	168
	Oct-Dec	8,9	88	4	7,5	47	14				2,9	34	11	13	26	41	7,2	34	29	4,2	55	8	0,4	97	1	44,1	21	108
	Total	44,6	30	50	63,8	15	91	1,6	92	3	17,8	33	43	70,2	13	175	61,9	14	183	37,7	50	44	18,0	35	31	315,6	9	620
Cod harvest angling with a angling license	Jan-Mar	55,4	57	8	39	70	7				5,2	82	3	110,4	19	73	80,6	35	42	4,2	59	3	5,5	60	5	311,9	16	141
	Apr-Jun	53,4	58	12	82,1	43	21				17,1	58	8	79,1	21	60	103,8	29	48	6,9	71	5	6,3	47	6	321,3	18	160
	Jul-Sep	52,5	48	11	112,9	34	21	0,8	77	2	9,7	43	10	93,4	16	79	80,9	32	51	58,8	74	12	9,5	70	7	385,7	18	193
	Oct-Dec	15,8	84	2	9,4	58	6				2,8	63	4	77,7	18	71	28,8	33	28	21,6	77	5	1,1	100	1	144,9	17	117
	Total	177,1	30	33	243,4	24	55	0,8	77	2	34,8	34	25	360,6	9	283	294,1	17	169	91,5	51	25	22,4	36	19	1163,8	9	611
Grand total	Angling	221,7	24	83	307,2	20	146	2,4	67	5	52,6	25	68	430,8	8	458	356,0	14	352	129,2	39	69	40,4	25	50	1479,4	7	1231
	Passive gear	4,1	48	9	23,0	33	28	1,6	69	10	13,6	21	61	41,1	43	63	66,5	13	245	18,5	25	55	18,0	32	23	186,4	8	494
	Total	225,8	24	92	330,2	18	174	4,0	49	15	66,2	20	129	471,9	8	521	422,5	12	597	147,7	34	124	58,4	20	73	1665,8	7	1725

Appendix B. Eel harvest (y) in tons per year with corresponding relative standard error (RSE). The number of respondents that reported a harvest within a given domain is denoted h.

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Total		
		y	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h
Eel harvest in fykenets	Jan-Mar	0,1	98	1				0,1	98	1	0,7	90	3	0,3	54	4	0,8	36	12	0,3	67	3				2,3	77	24
	Apr-Jun				0,0	98	1	1,2	40	11	5,2	79	9	0,4	55	5	2,8	22	37	1,0	40	8				10,6	43	71
	Jul-Sep	0,6	52	5	6,6	89	2	11,3	19	50	11,9	19	58	6,5	62	15	28,1	17	99	4,9	24	26	1,3	57	5	71,2	12	260
	Oct-Dec	0,1	72	3				1,2	40	12	4,3	48	18	4,9	42	16	18,3	34	69	3,2	33	20	0,2	70	2	32,2	21	140
	Total	0,8	42	9	6,6	89	3	13,8	16	74	22,1	23	88	12,1	37	40	50,0	16	217	9,4	17	57	1,5	50	7	116,3	10	495

Appendix C. Seatrout harvest (*y*) in tons per year with corresponding relative standard error (RSE). The number of respondents that reported a release within a given domain is denoted h.

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Fresh water			Total		
		y	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h
Trout harvest in fykenets	Jan-Mar																0,0	98	1										0,0		1
	Apr-Jun							0,1	98	1	0,1	98	1				0,8	88	3	0,0	98	1							1,0	72	6
	Jul-Sep				1	97	1	0,3	80	3	0,0	97	1				1,3	36	10										2,6	42	15
	Oct-Dec				2	97	1				0,1	58	3	0,4	75	2	0,4	44	6	0,1	97	1							3,0	99	13
	Total				3,0	72	2	0,4	65	4	0,2	57	5	0,4	75	2	2,5	35	20	0,1	97	2							6,6	49	35
Trout harvest in gillnets	Jan-Mar	0,1	98	1	0,1	98	1	0,8	65	4	1,7	33	10	0,4	52	5	1,7	35	13	1,2	57	4							6,0	33	38
	Apr-Jun	0,2	76	2	0,2	59	3	1,1	31	12	6	25	32	0,9	52	5	5,6	30	33	1,1	46	6	0,2	69	2				15,3	18	95
	Jul-Sep	0,3	58	3	0,8	97	1	3,5	31	21	7,6	26	34	2,8	37	11	6,1	20	52	1,3	54	7	0,3	97	1				22,7	13	130
	Oct-Dec	0,1	70	2	0,2	97	1	1,9	33	13	2,9	44	12	1,9	50	8	2,5	33	20	1,5	59	6	0,2	97	1				11,2	22	63
	Total	0,7	37	8	1,3	63	6	7,3	19	50	18,2	16	88	6,0	25	29	15,9	15	118	5,1	28	23	0,7	54	4				55,2	8	326
Trout harvest angling with a passive gear license	Jan-Mar							0,7	63	5	1,9	43	9	1,5	67	7	3,5	20	34	3	69	6	2,3	87	4	0,9	45	6	12,9	29	65
	Apr-Jun							0,6	51	5	2,9	40	21	1,8	41	14	5,8	25	56	5,6	73	11	3	69	7	1,6	32	15	19,7	26	114
	Jul-Sep	0,2	97	1	0,4	97	1	1,6	56	8	2,6	25	28	2,9	52	9	8	34	49	1	84	4	0,6	78	3	2,6	37	16	17,3	21	103
	Oct-Dec	0,2	70	2				0,4	66	3	0,7	43	9	1	70	6	2	45	18	0,6	58	3	0,3	69	2	0,8	54	5	5,2	46	43
	Total	0,4	60	3	0,4	97	1	3,3	33	21	8,1	20	67	7,2	29	36	19,3	17	157	10,2	46	24	6,2	47	16	5,9	21	42	61,0	11	367
Trout harvest angling with a angling license	Jan-Mar	0,8	100	1				9,2	49	8	18,3	33	22	10,4	51	13	36,2	21	52	8,6	35	13	3,6	61	5	13,2	60	13	100,3	14	127
	Apr-Jun	2	60	3	0,2	100	1	10,1	41	14	25,6	30	38	16,1	41	23	45,7	21	81	6,5	40	11	4,8	37	10	22,1	26	26	133,1	11	207
	Jul-Sep	0,8	100	1	1,4	80	2	11,5	38	15	26,9	31	28	20,9	42	21	39,5	18	78	39	64	14	7,9	71	3	37,3	18	57	185,2	16	219
	Oct-Dec	0,8	100	1				3,4	38	9	12,7	40	21	6,6	46	9	16,3	28	37	8	40	12	2,3	54	4	8,5	30	18	58,6	14	111
	Total	4,4	42	6	1,6	71	3	34,2	22	46	83,5	17	109	54,0	23	66	137,7	11	248	62,1	41	50	18,6	34	22	81,1	15	114	477,2	8	664
Grand total	Angling	4,8	39	9	2,0	60	4	37,5	21	67	91,6	15	176	61,2	21	102	157,0	10	405	72,3	36	74	24,8	28	38	87,0	14	156	538,2	7	1031
	Passive gear	0,7	37	8	4,3	54	8	7,7	18	54	18,4	15	93	6,4	24	31	18,4	13	138	5,2	27	25	0,7	54	4				61,8	9	361
	Total	5,5	34	17	6,3	41	12	45,2	17	121	110,0	13	269	67,6	19	133	175,4	9	543	77,5	33	99	25,5	28	42	87,0	14	156	600,0	6	1392

Appendix D: Cod release (*y*) in numbers per year with corresponding relative standard error (RSE). The number of respondents that reported a release within a given domain is denoted h.

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arko Sea			Eastern Baltic			Total		
		y	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h
Cod release in fykenets	Jan-Mar																1102	55	5							1102	55	5
	Apr-Jun				4159	98	1	21	98	1	104	80	2				2246	40	8							6530	64	12
	Jul-Sep							2191	90	3	583	71	3	1829	81	4	28338	35	19	201	97	1				33141	31	30
	Oct-Dec							201	97	1				4422	68	3	7778	44	14	804	71	2				13204	26	20
	Total				4159	98	1	2412	82	5	687	61	5	6250	54	7	39463	27	46	1005	60	3				53977	21	67
Cod release in gillnets	Jan-Mar										104	98	1	42	98	1	1165	48	7							1310	43	9
	Apr-Jun				208	98	1	21	98	1	166	62	3	458	89	2	2412	33	18	603	72	3	1664	68	3	5531	27	31
	Jul-Sep				101	97	1				161	62	3	1025	43	7	3758	25	23	241	83	2	382	62	3	5668	18	39
	Oct-Dec				101	97	1				60	97	1	3618	97	1	1467	47	9	80	97	1	80	97	1	5406	13	14
	Total				409	60	3	21	98	1	492	38	8	5142	69	11	8802	17	57	925	52	6	2126	54	7	17915	11	93
Cod release angling with a passive gear license	Jan-Mar	5895	44	9	10923	38	14	125	98	1	1618	59	5	109782	83	43	14165	27	44	5095	46	8	2932	64	7	150535	5	131
	Apr-Jun	16411	23	28	20661	21	38	1456	98	1	9934	55	12	20056	31	41	22244	23	60	23704	77	18	6195	39	15	120659	17	213
	Jul-Sep	13697	72	9	22654	30	25	20	97	1	3668	45	15	20003	22	50	79797	81	49	3819	56	10	8602	64	8	152259	43	167
	Oct-Dec	8944	88	4	7529	47	14				2968	34	11	13082	26	41	6672	36	29	4150	55	8	442	97	1	43787	21	108
	Total	44946	30	50	61767	16	91	1601	89	3	18188	32	43	162923	56	175	122878	53	182	36767	51	44	18171	35	31	467240	15	619
Cod release angling with a angling license	Jan-Mar	4803	47	8	4803	49	7				6845	59	4	85137	27	79	115277	38	46	1681	58	3	6724	65	6	225270	20	153
	Apr-Jun	6965	39	12	24376	53	22				12368	56	11	110834	32	64	103389	24	56	4443	69	6	12248	58	7	274623	11	178
	Jul-Sep	8848	56	11	78657	51	21	1079	100	2	21472	55	10	128937	30	84	143611	28	58	23629	36	14	7121	60	7	413354	14	207
	Oct-Dec	3561	72	2	8848	91	6				10466	61	5	55028	25	73	82110	27	33	6798	46	7	324	100	1	167133	15	127
	Total	24176	27	33	116684	37	56	1079	100	2	51150	31	30	379935	16	300	444387	15	193	36551	26	30	26418	35	21	1080380	8	665
Grand total	Angling	69122	22	83	178451	25	147	2679	67	5	69338	24	73	542858	20	475	567265	17	375	73318	29	74	44588	25	52	1547620	7	1284
	Passive				4568	89	4	2433	81	6	1178	39	13	11392	43	18	48265	22	103	1930	40	9	2126	54	7	71892	16	160
	Total	69122	22	83	183019	24	151	5113	52	11	70516	24	86	554250	20	493	615530	15	478	75247	28	83	46714	24	59	1619512	7	1444

Appendix E: Eel release (*y*) in numbers per year with corresponding relative standard error (RSE). The number of respondents that reported a release within a given domain is denoted h.

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arko Sea			Eastern Baltic			Total		
		y	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h
Eel release in fykenets	Jan-Mar										62	98	1	104	98	1	83	98	1							250	41	3
	Apr-Jun							42	69	2	458	54	5	21	98	1	915	48	5	42	98	1				1477	34	14
	Jul-Sep	402	97	1	6029	97	1	7095	39	19	7034	30	22	2412	59	5	10431	27	27	1447	51	4	3417	75	2	38266	20	81
	Oct-Dec	402	97	1				603	68	4	2432	74	6	1889	93	3	4321	34	16	1005	79	3	20	97	1	10672	24	34
	Total	804	69	2	6029	97	1	7739	36	25	9986	28	34	4426	51	10	15750	20	49	2494	43	8	3437	75	3	50664	16	132

Appendix F: Seatrout release (*y*) in numbers per year with corresponding relative standard error (RSE). The number of respondents that reported a harvest within a given domain is denoted h.

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Fresh water			Total		
		y	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h	*y*	RSE	h
Trout release in fykenets	Jan-Mar																													
	Apr-Jun							42	98	1							416	98	1										458	90	2
	Jul-Sep				985	97	1	965	97	1	201	97	1				261	78	2										2412	57	5
	Oct-Dec				1005	97	1				201	97	1				302	65	3										1507	67	5
	Total				1990	69	2	1006	93	2	402	69	2				979	51	6										4377	40	12
Trout release in gillnets	Jan-Mar										104	98	1	104	98	1	208	65	3	104	98	1							520	38	6
	Apr-Jun	42	98	1	42	98	1	125	51	4	166	60	3	146	98	1	312	62	4										832	28	14
	Jul-Sep	201	97	1				221	58	5	884	44	11	40	69	2	1809	58	11										3155	36	30
	Oct-Dec	60	97	1				281	85	2	101	52	4				80	69	2										523	49	9
	Total	303	69	3	42	98	1	627	44	11	1255	33	19	290	61	4	2409	45	20	104	98	1							5030	24	59
Trout release angling with a passive gear license	Jan-Mar	458	98	1				624	59	6	2974	70	9	853	65	7	5490	25	40	478	46	7	250	60	5	940	45	6	12065	22	81
	Apr-Jun	333	98	1				1518	42	8	7236	61	23	624	54	15	5781	27	59	645	38	11	125	69	8	1649	32	15	17910	27	140
	Jul-Sep	0		1	1005	97	1	2633	43	8	3397	27	30	1487	65	10	9305	35	50	322	67	4	302	80	3	2593	37	3	21043	18	110
	Oct-Dec	241	70	2	402	97	1	563	64	4	804	65	10	1286	55	6	2291	37	20	523	78	3	60	73	2	752	54	4	6922	18	52
	Total	1031	56	5	1407	75	2	5337	26	26	14410	35	72	4250	32	38	22867	17	169	1967	29	25	736	41	18	5934	21	28	57940	12	383
Trout release angling with a angling license	Jan-Mar	961	100	1				9967	49	9	44189	35	26	10927	47	13	52475	28	59	9726	38	14	20894	86	6	9486	34	18	158625	18	146
	Apr-Jun	1561	72	3	240	100	1	9486	35	16	53796	62	48	15610	36	24	42388	20	97	4563	42	15	4923	64	11	12008	35	35	144576	24	250
	Jul-Sep	755	71	2	1834	94	2	30535	50	19	49848	32	34	25895	31	28	88799	18	98	27730	78	15	1187	91	2	41540	21	68	268124	13	268
	Oct-Dec	539	100	1				10790	46	11	11006	28	25	9495	59	14	37656	27	51	7445	73	14	2266	74	4	16616	38	25	95813	15	145
	Total	3816	44	7	2074	84	3	60778	28	55	158839	157	21	61928	20	79	221319	11	305	49464	46	58	29270	63	23	79650	15	146	667139	9	697
Grand total	Angling	4848	36	12	3481	58	5	66115	26	81	173250	144	93	66178	19	117	244186	11	474	51431	44	83	30006	61	41	85584	14	174	725078	8	1080
	Passive	303	69	3	2031	67	3	1634	60	13	1657	30	21	290	61	4	3388	35	26	104	98	1							9407	23	71
	Total	5151	34	15	5513	44	8	67748	25	94	174907	143	114	66468	19	121	247573	10	500	51535	44	84	30006	61	41	85584	14	174	734485	8	1151

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